NCG TECHNICAL REPORT NO. 19

THE NCG FALLOUT SCALING MODEL:

A GRAPHIC-NUMERICAL METHOD OF PREDICTING FALLOUT PATTERNS FOR NUCLEAR CRATERING DETONATIONS

CAPTAIN DONALD E. BURTON

U. S. Army Engineer Nuclear Cratering Group
Lawrence Radiation Laboratory
Livermore, California

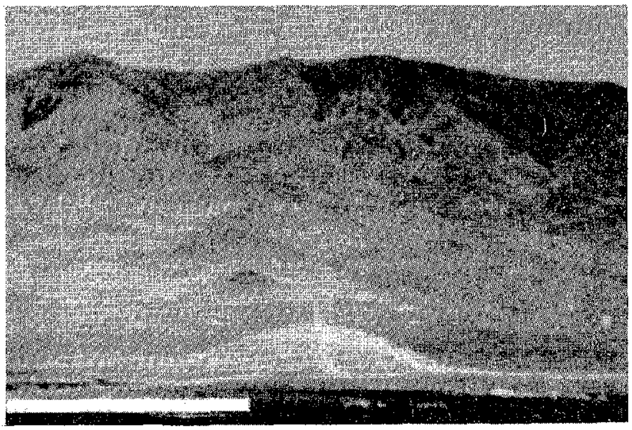
January 1970

92

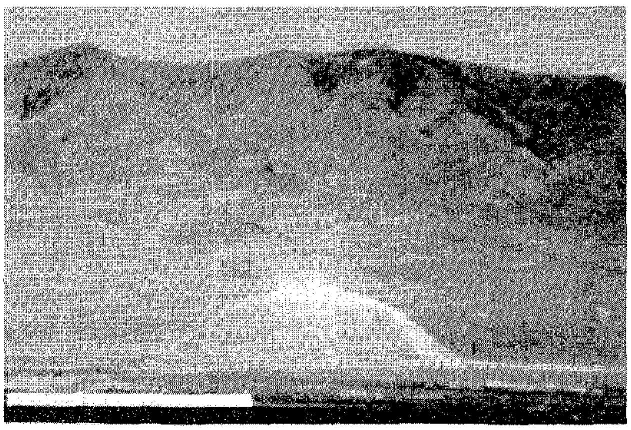
TABLE 1

Observed cloud and fallout parameters

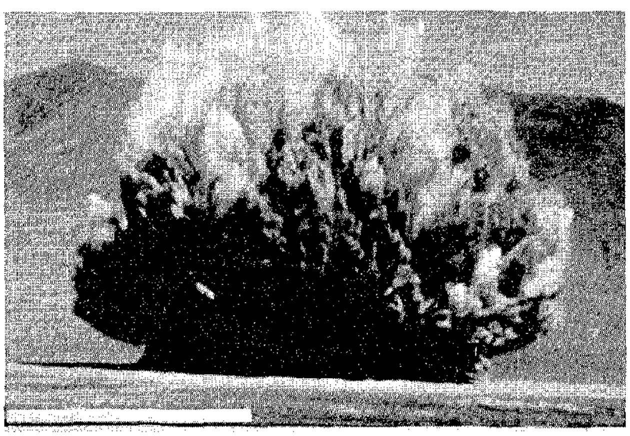
Event	DANNY BOY	CABRIOLET	BUGGY	SEDAN	TEAPOT ESS	SCHOONER	JANGLE U	JANGLE S	JOHNIE BOY
Yield (kt)	.42	2.5	5.5	100	1.2	35	1.2	1.2	.5
W_{fo} (tons)	17	7	35	2000	700	425	670	550	225
sdob($f/kt^{1/3.4}$)	139	130	131	164	64	126	15	-3.2	2.5
Media	Basalt	Rhyolite	Basalt	Alluvium	Alluvium	Basalt	Alluvium	Alluvium	Alluvium
Soil Moisture Content (%)	<1	<1	<1	10-15	"wet"	10 ave.			"wet"
R_b (m)	500	732	780	4000	2440	2040	670	----	----
H_b (m)	430	550	305	1200	1220	550	930	----	----
R_m (m)	----	----	152	900	137	1110	100	747	340
H_m (m)	----	----	773	3600	2440	4180	1860	3290	3610 top 2260 bottom
Shear (°)	5	15	5	30	22	80	15	30	30
V (m/s)	7.7	10.2	7.5	5.6	7.1	9.7	~7	~7	~7
References	3, 9, 10	8, 9, 11	8, 9, 12	1, 3, 9, 10	3, 10	8, 13	3, 10	10	10



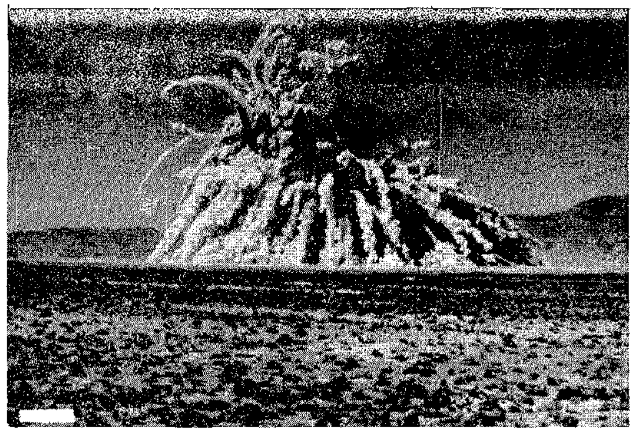
(a) Formation of mound (H+1. 9 sec)



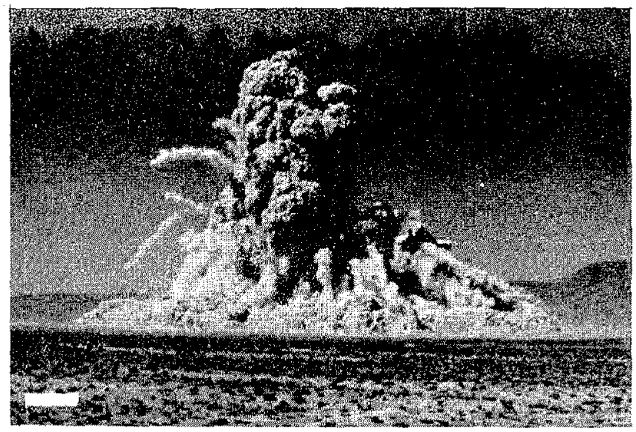
(b) Venting through fissures in mound material (H+2. 8 sec)



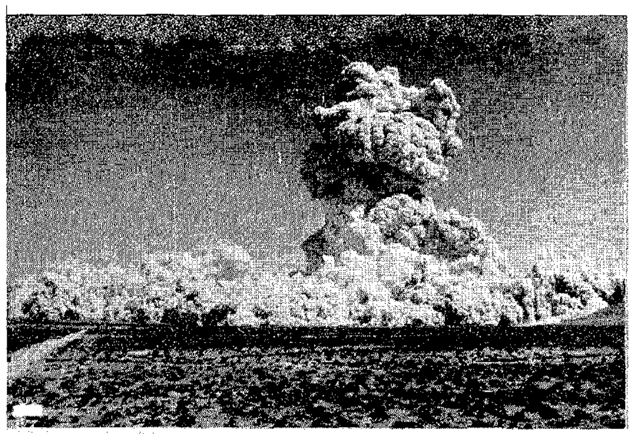
(c) Complete dissociation and ejection of mound material (H+4 sec)



(d) Formation of main cloud and fallback of ejecta (H+27 sec)



(e) Formation of base surge (H+39 sec)



(f) Stabilization of cloud structure (H+6 min)

Figure 1. Cloud formation history through time of cloud stabilization. Scale: BAR = 300 meters.

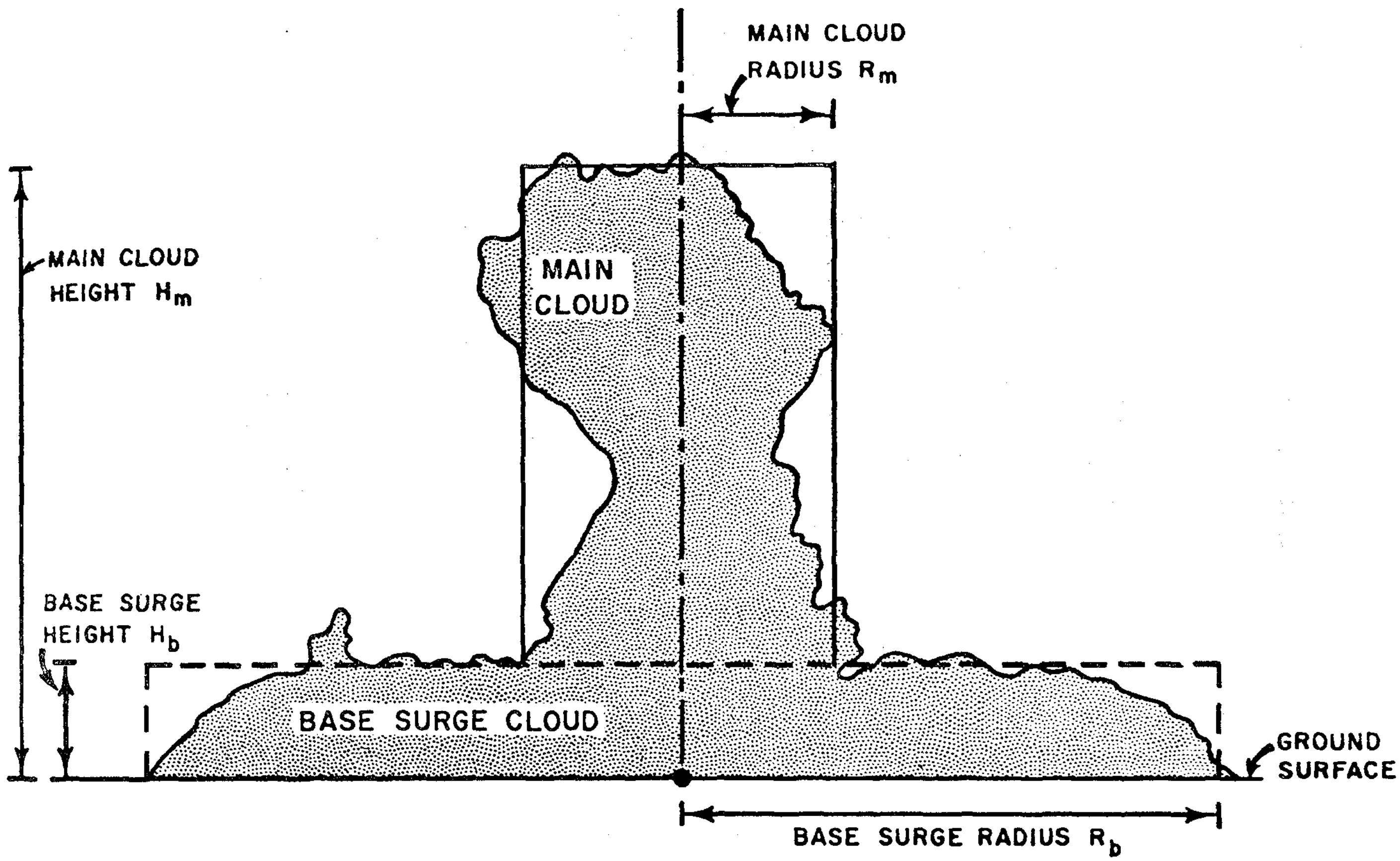


Figure 2. Definition of cloud dimensions and symbols

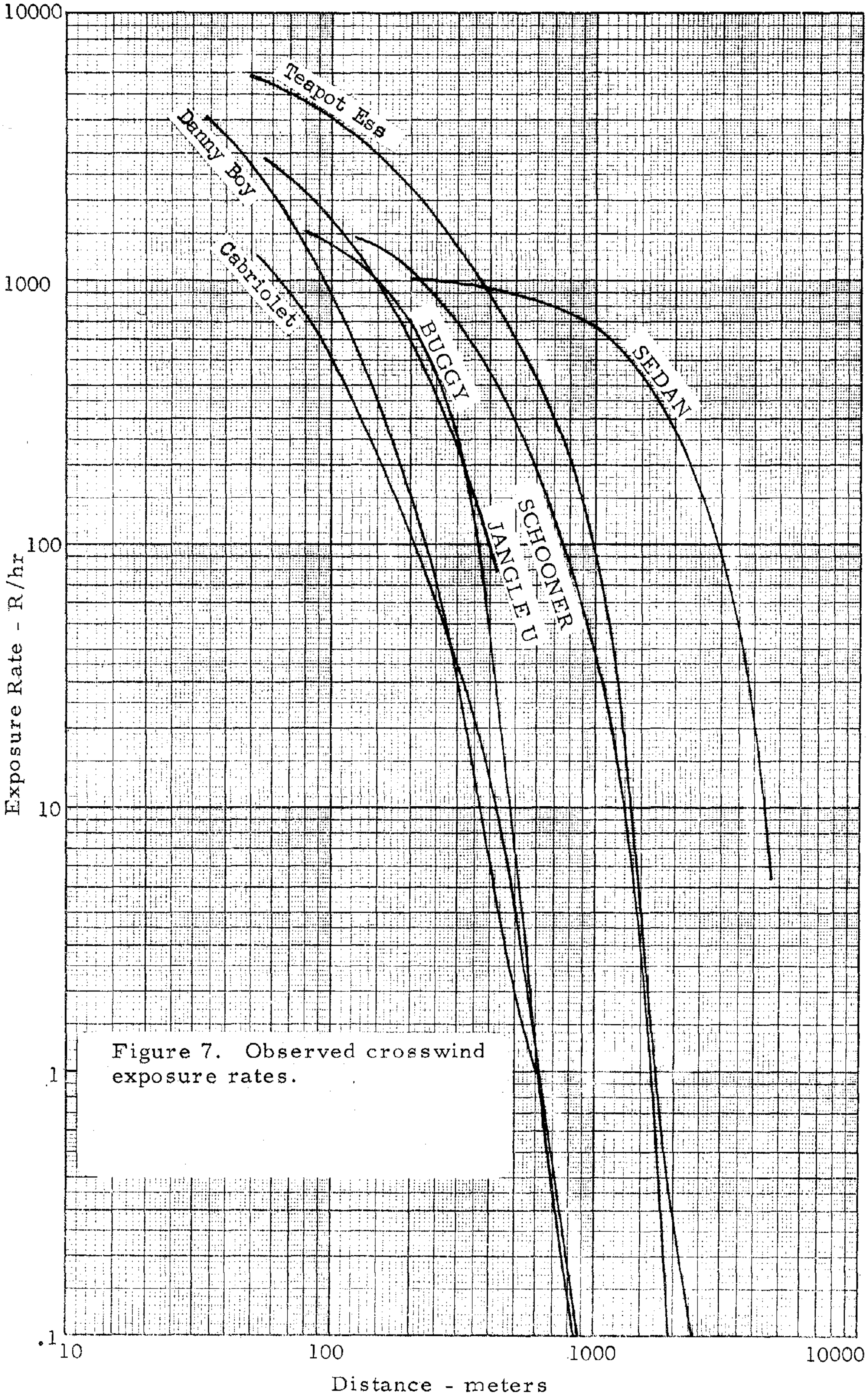


Figure 7. Observed crosswind exposure rates.

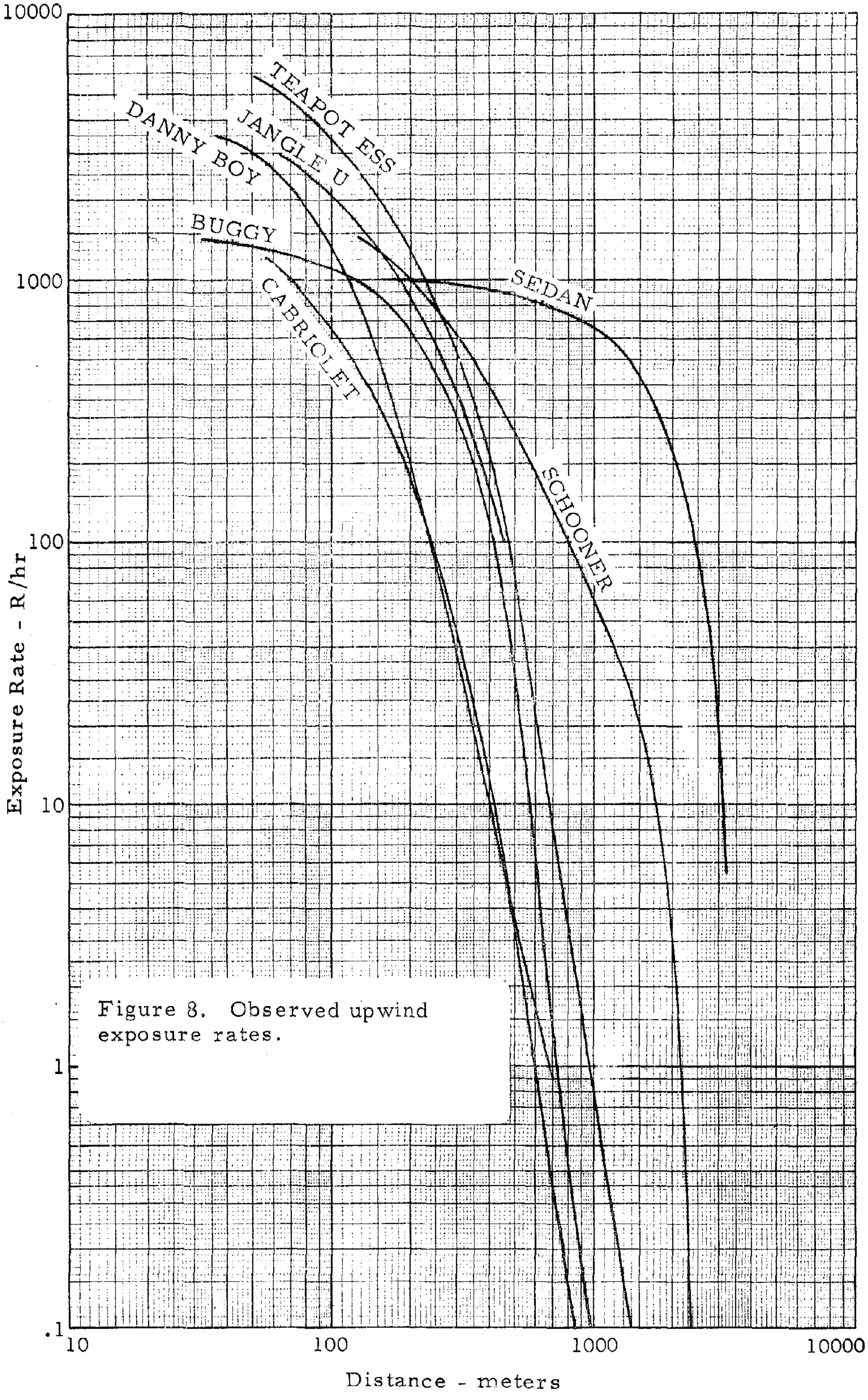


Figure 8. Observed upwind exposure rates.

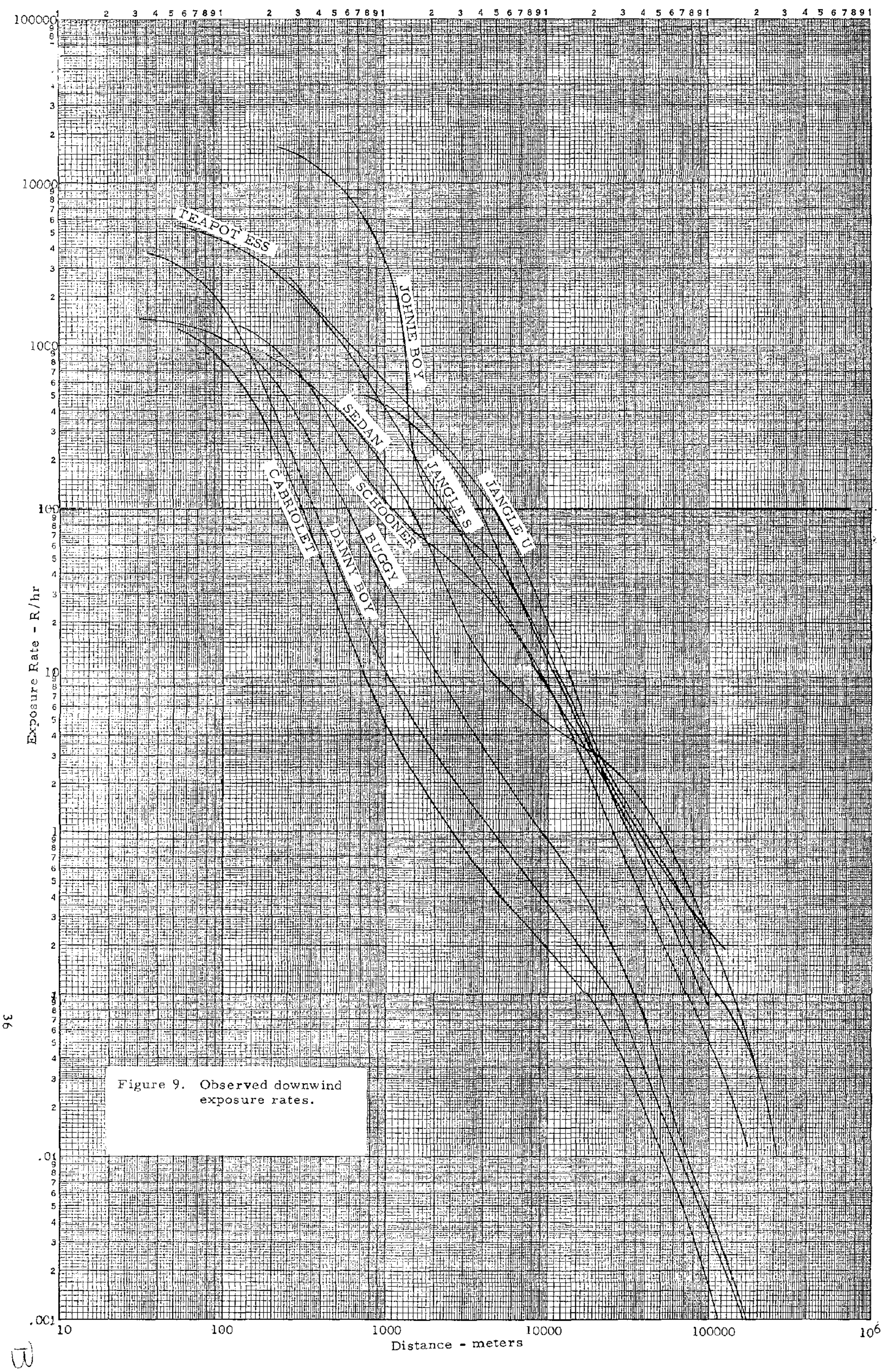


Figure 9. Observed downwind exposure rates.

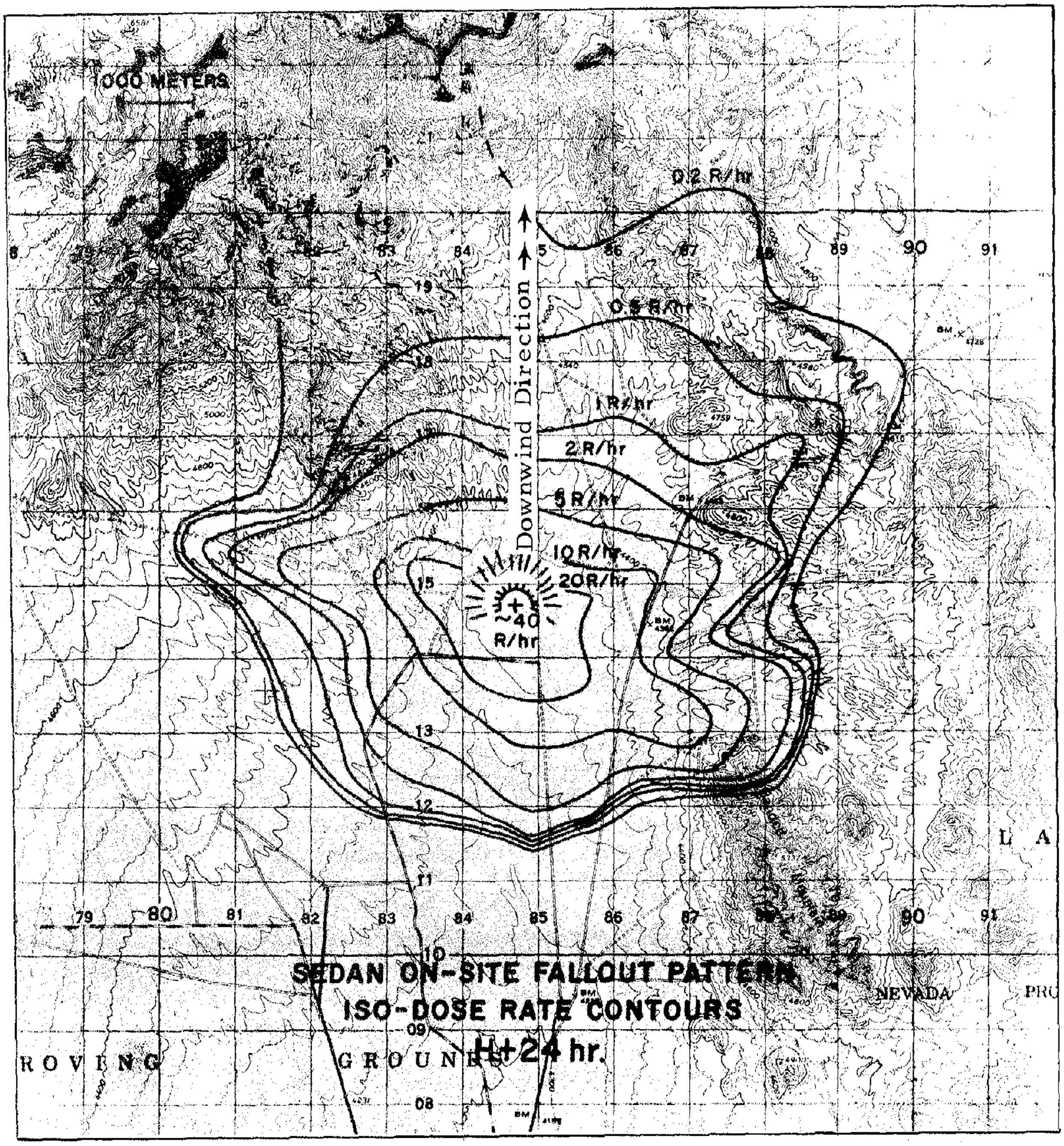


Figure 13. SEDAN on-site fallout pattern, iso-exposure rate contours at H+24 hours.

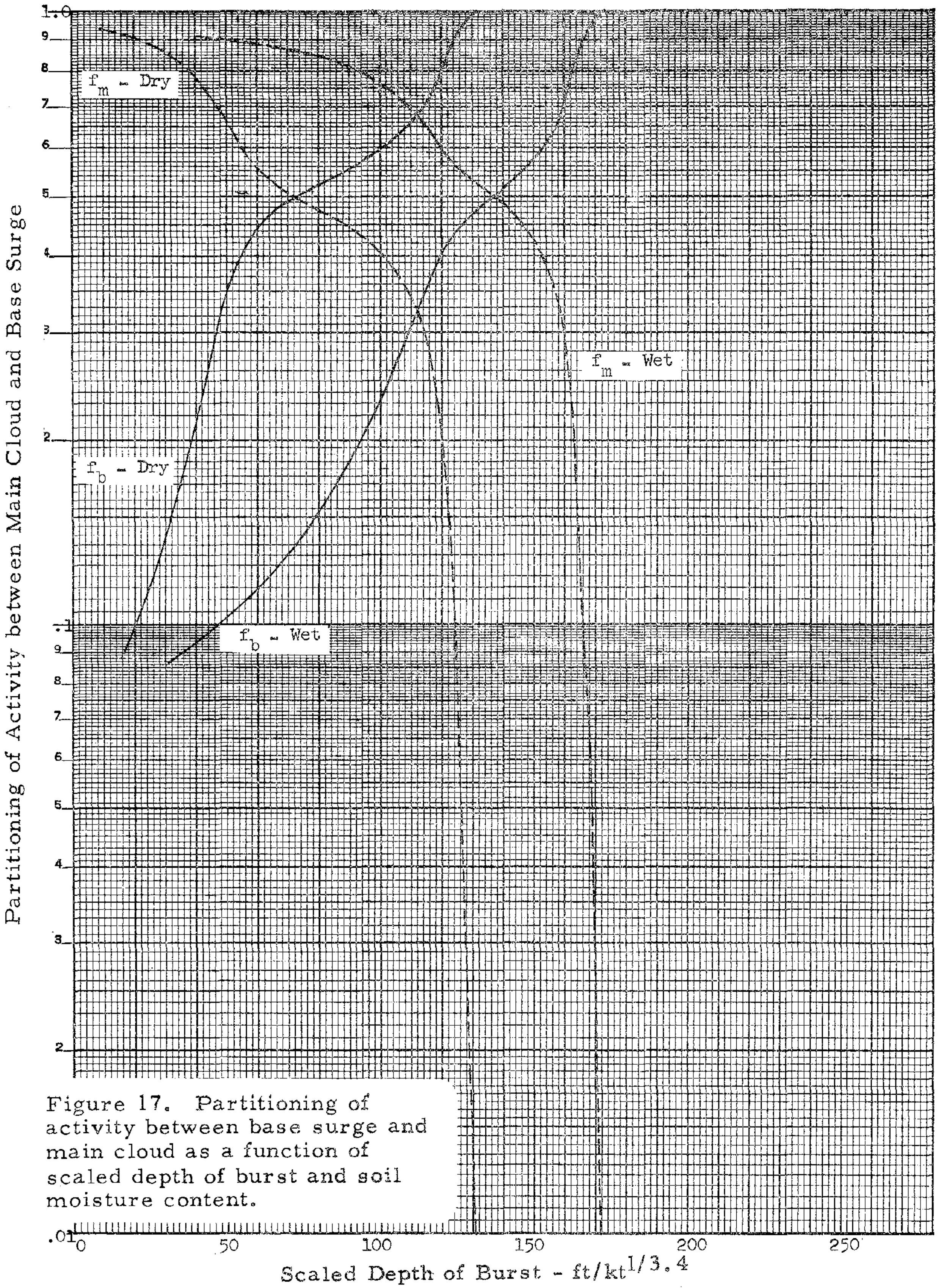


Figure 17. Partitioning of activity between base surge and main cloud as a function of scaled depth of burst and soil moisture content.

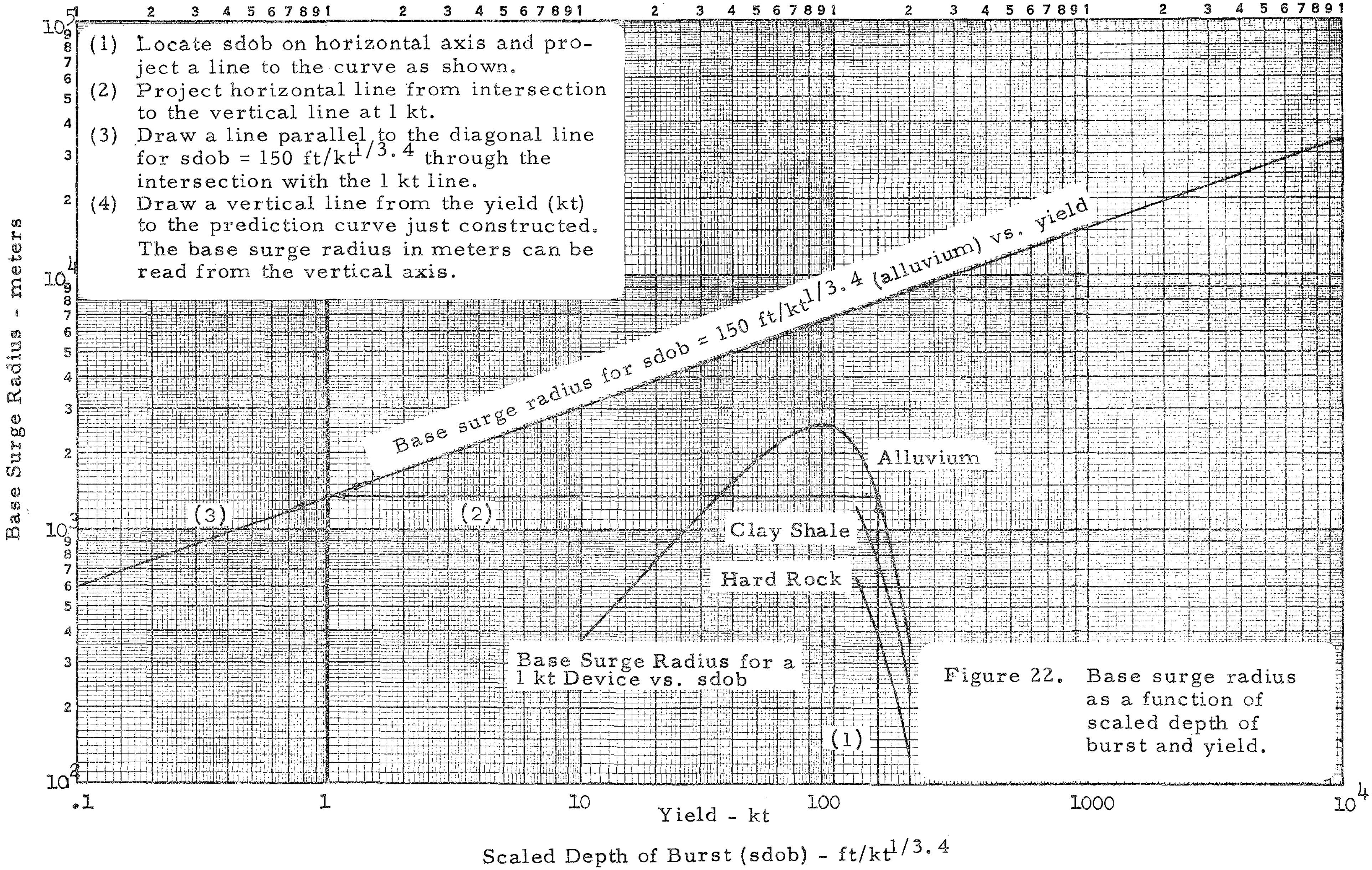


Figure 22. Base surge radius as a function of scaled depth of burst and yield.

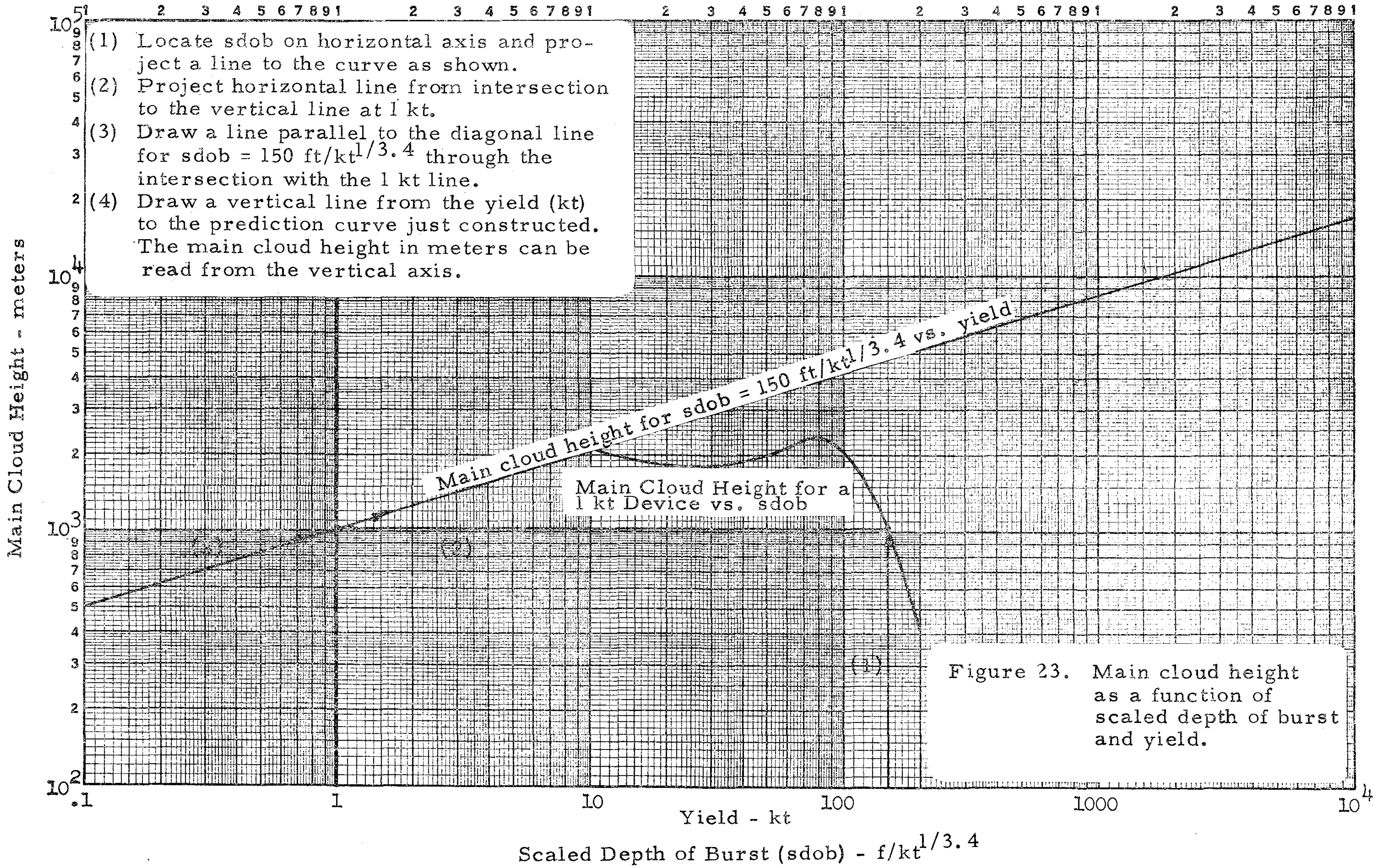


Figure 23. Main cloud height as a function of scaled depth of burst and yield.

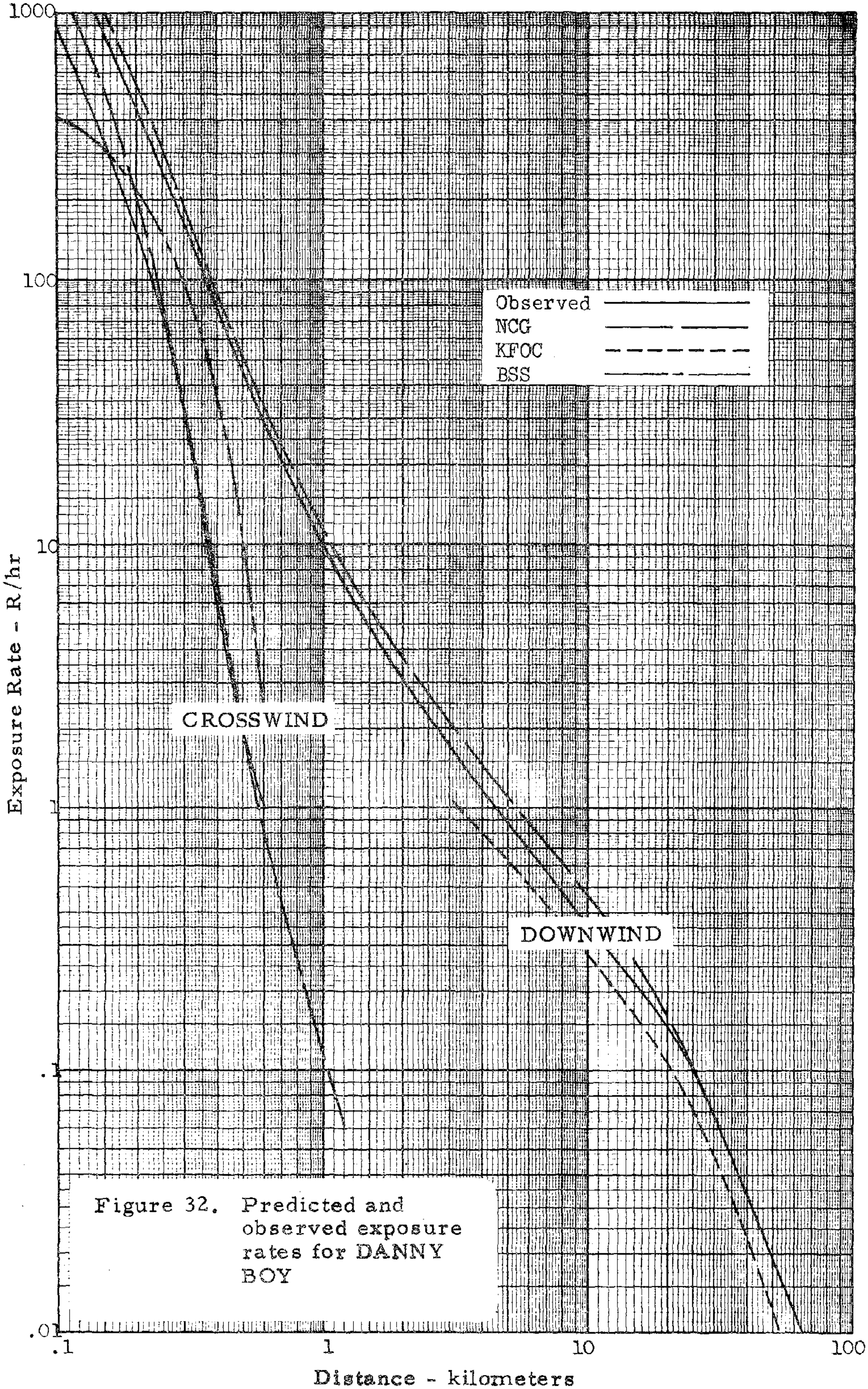


Figure 32. Predicted and observed exposure rates for DANNY BOY

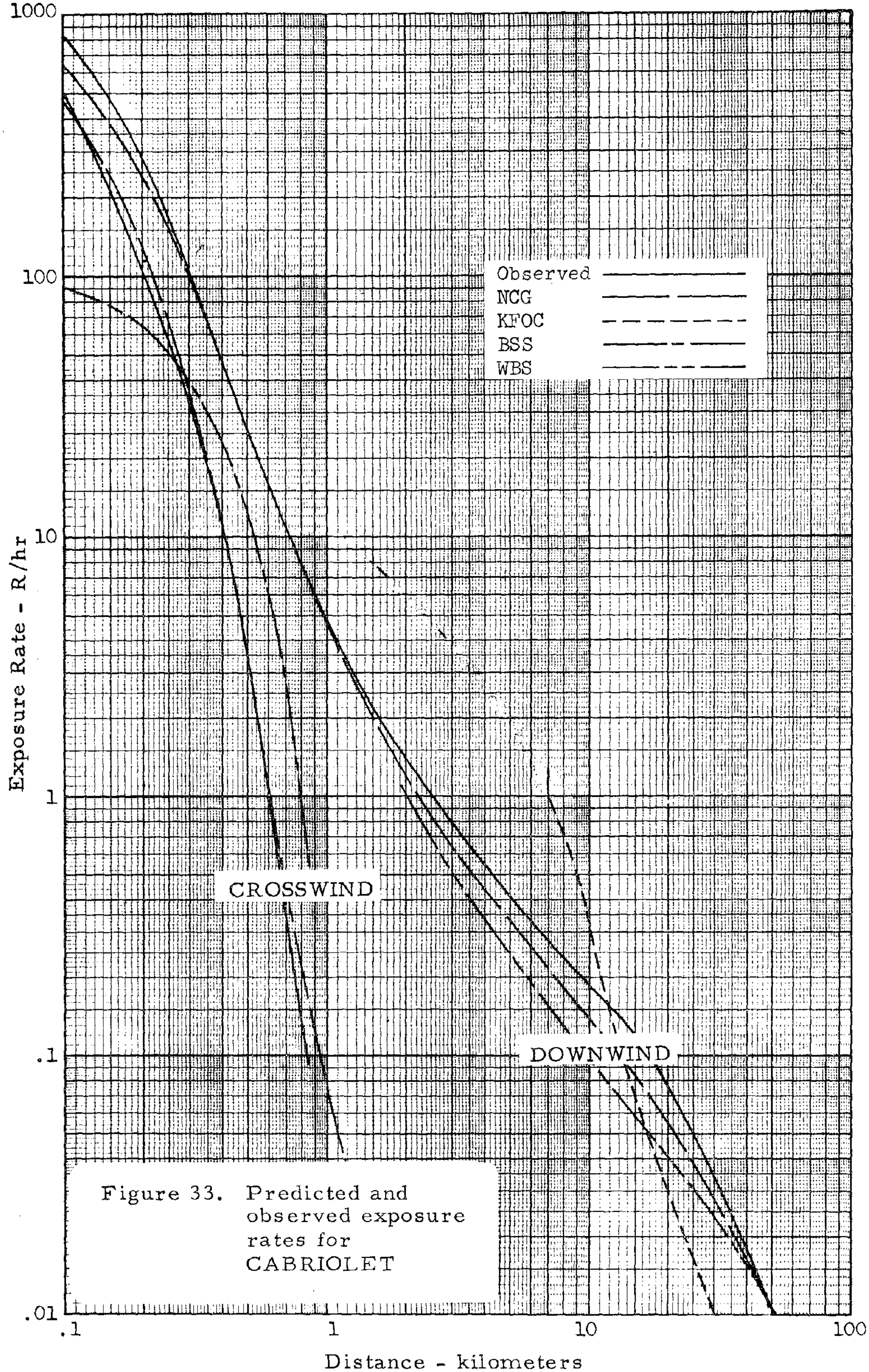


Figure 33. Predicted and observed exposure rates for CABRIOLET

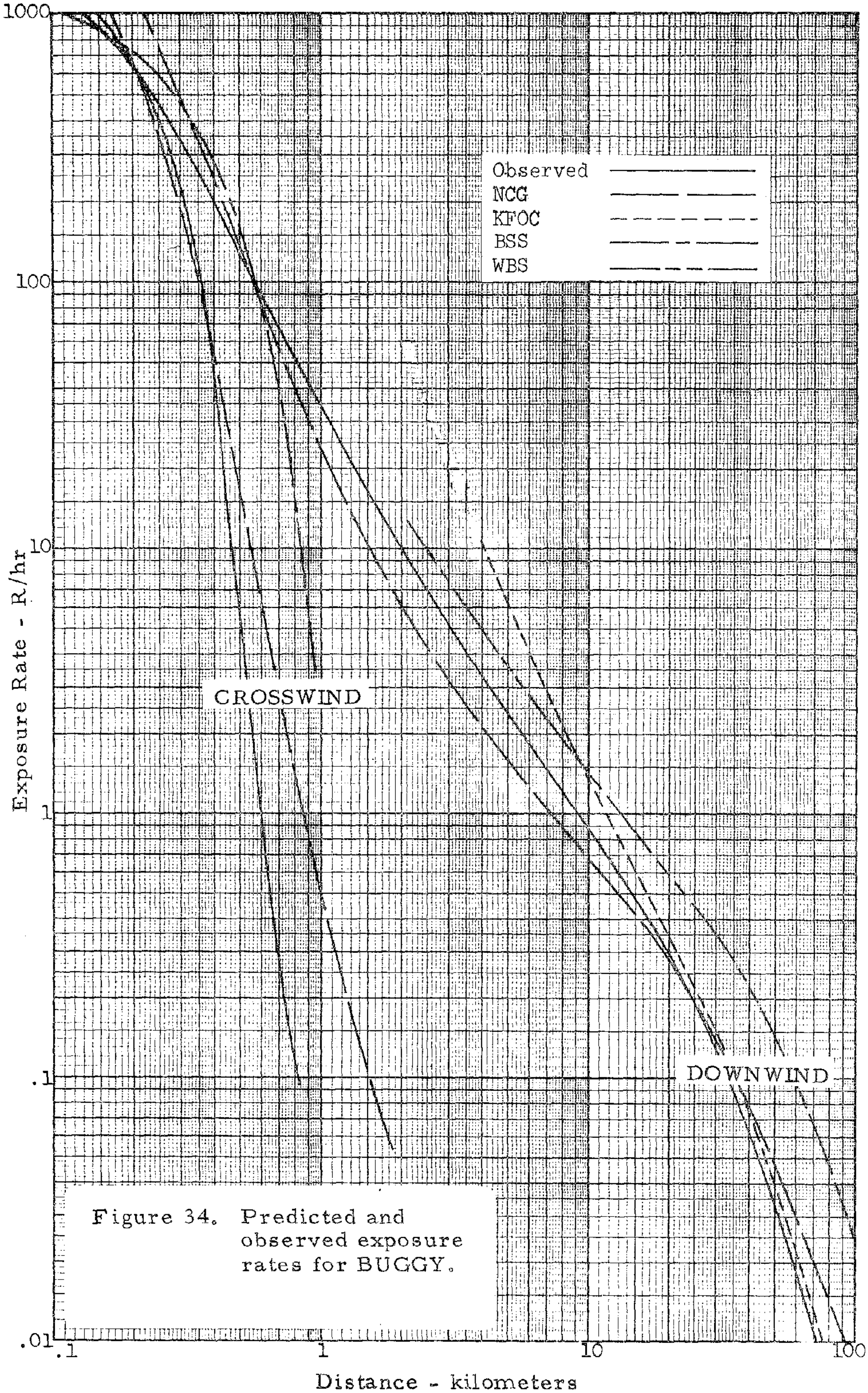


Figure 34. Predicted and observed exposure rates for BUGGY.

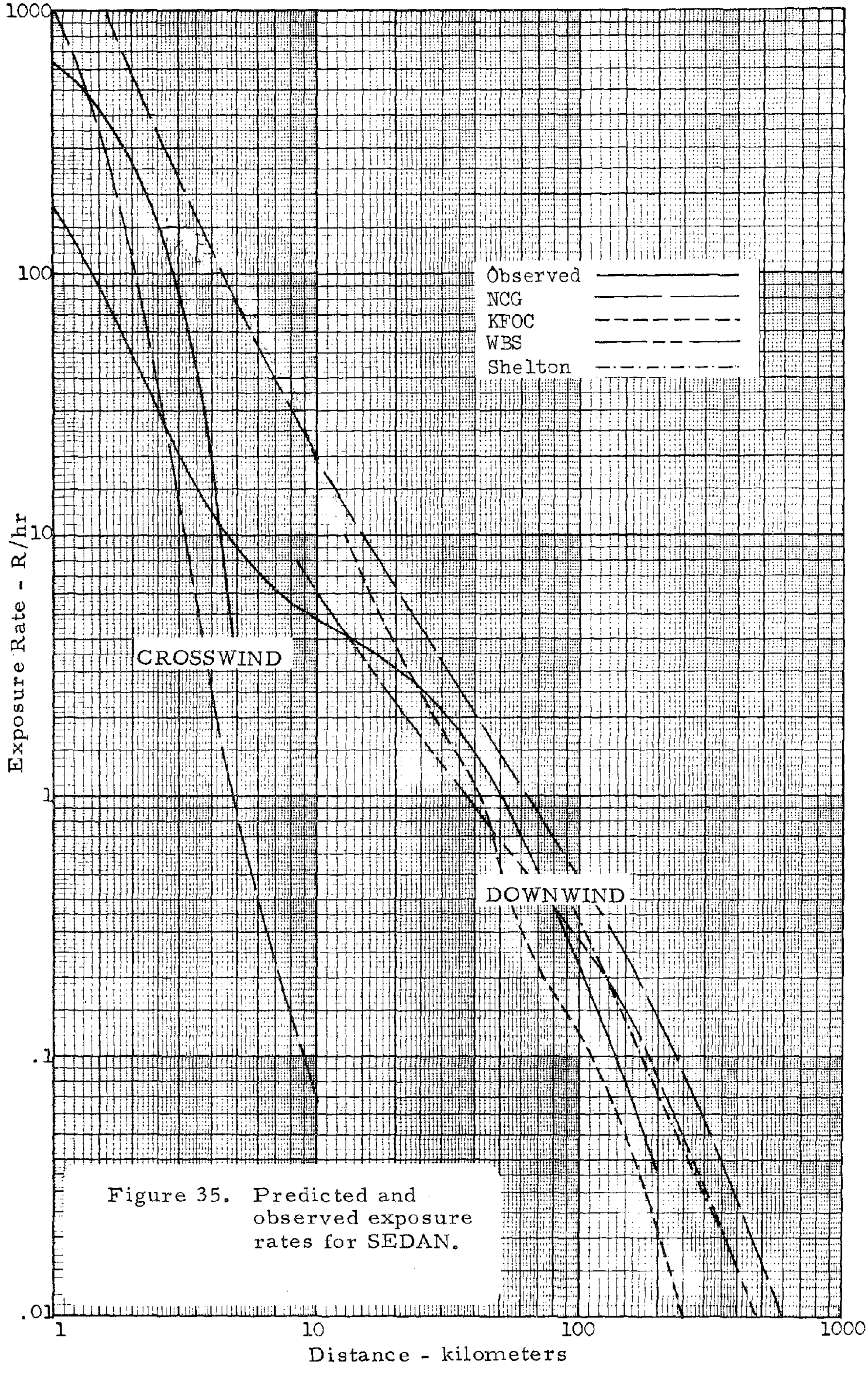


Figure 35. Predicted and observed exposure rates for SEDAN.

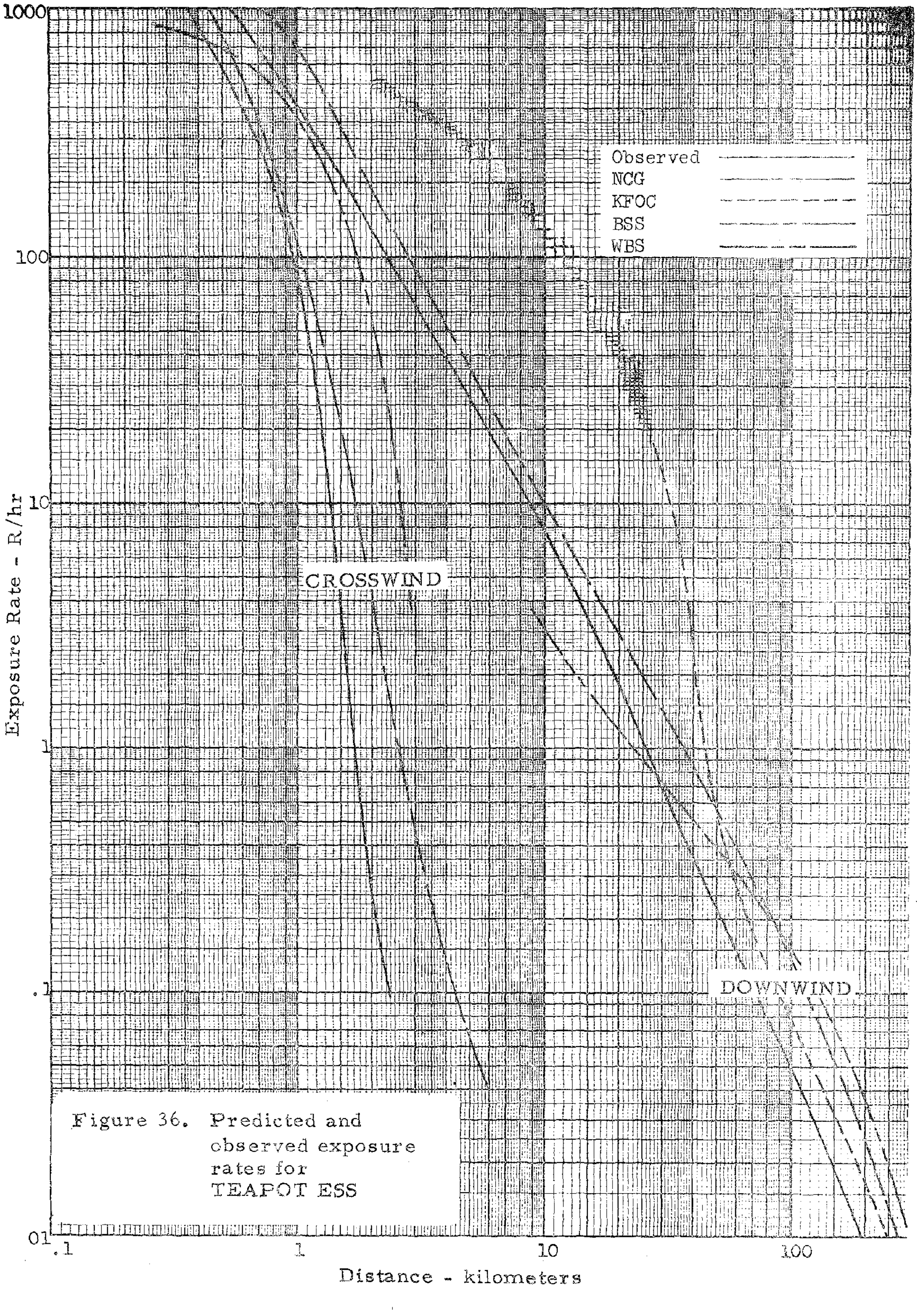


Figure 36. Predicted and observed exposure rates for TEAPOT ESS

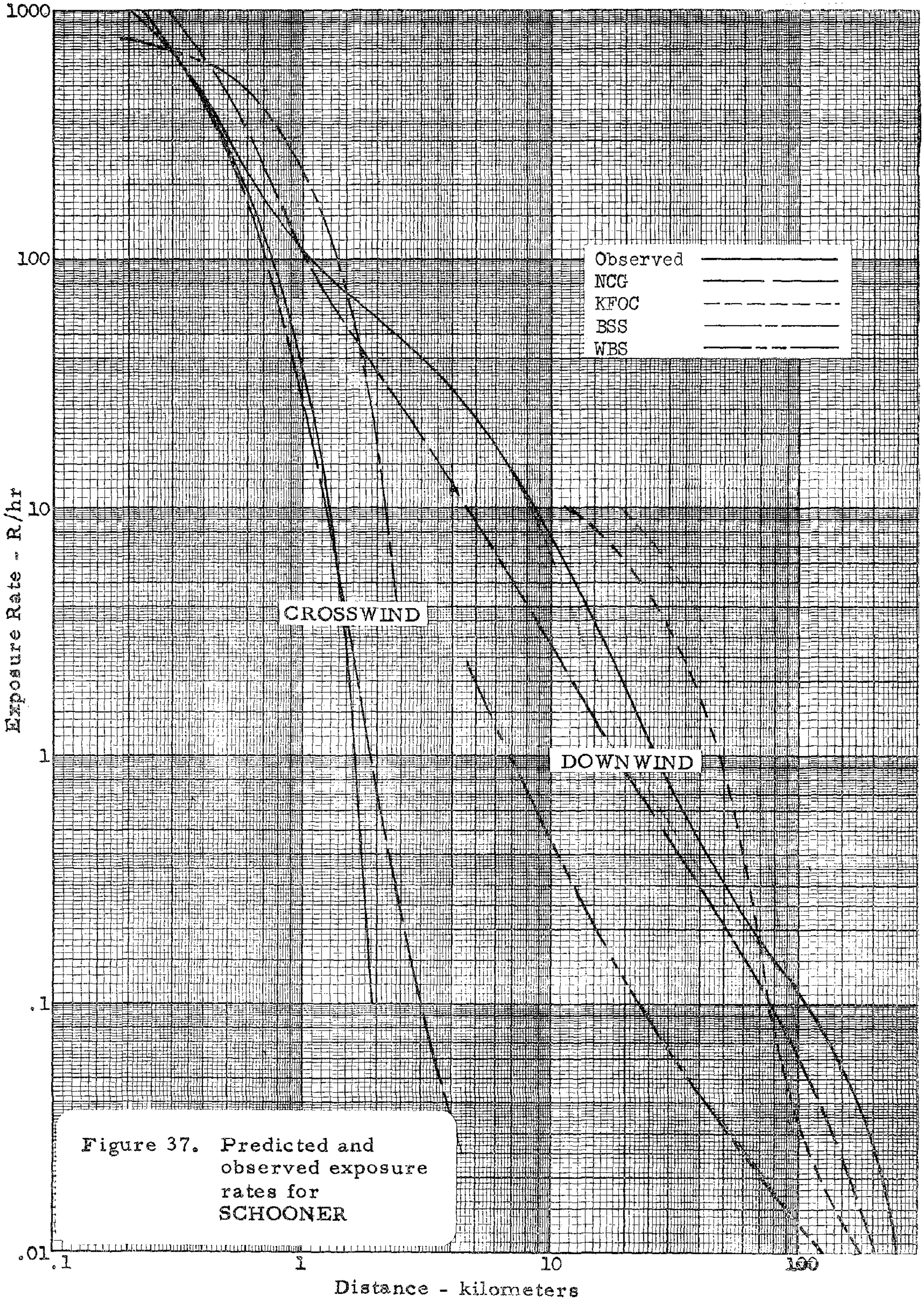


Figure 37. Predicted and observed exposure rates for SCHOONER

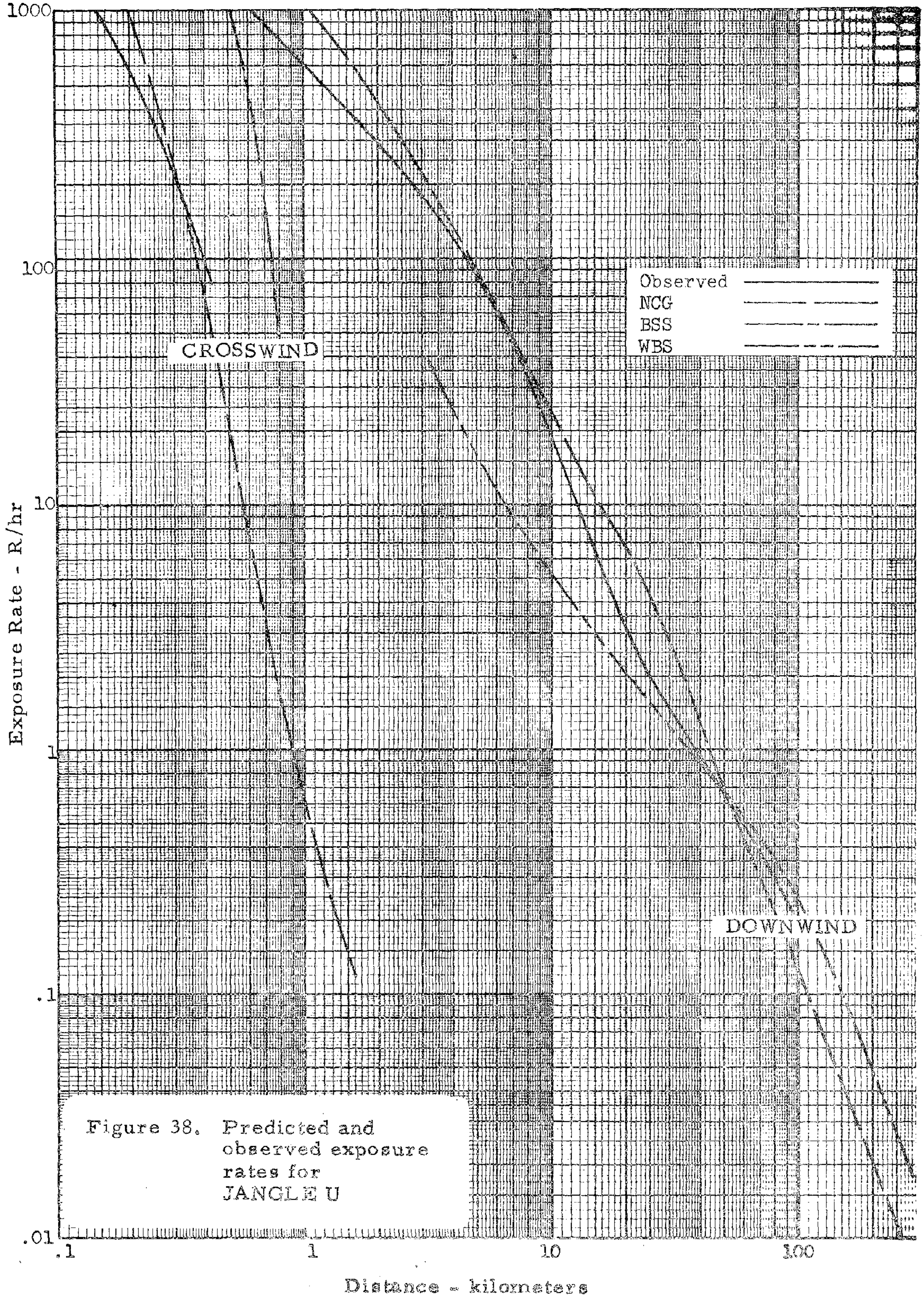


Figure 38. Predicted and observed exposure rates for JANGLE U

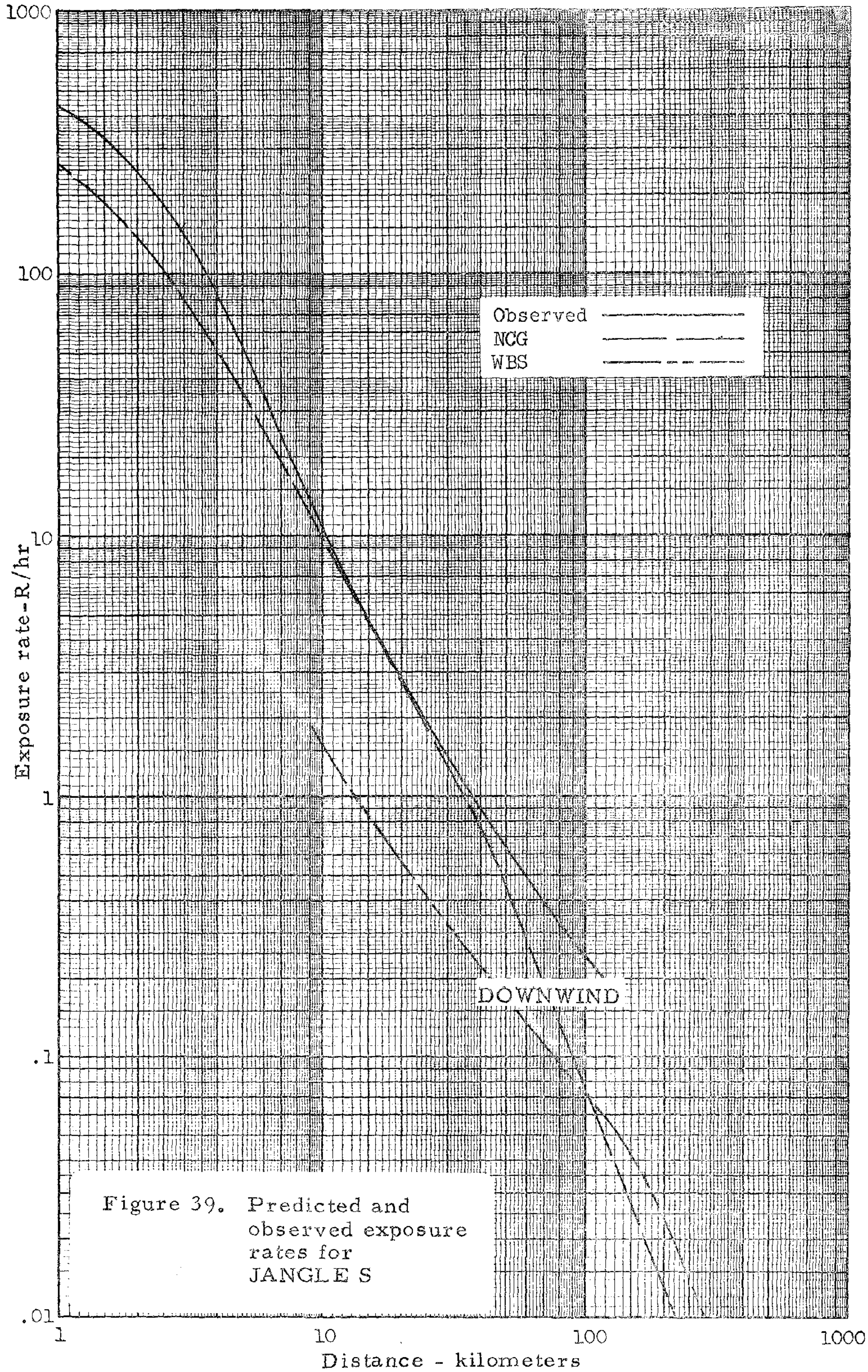


Figure 39. Predicted and observed exposure rates for JANGLE S

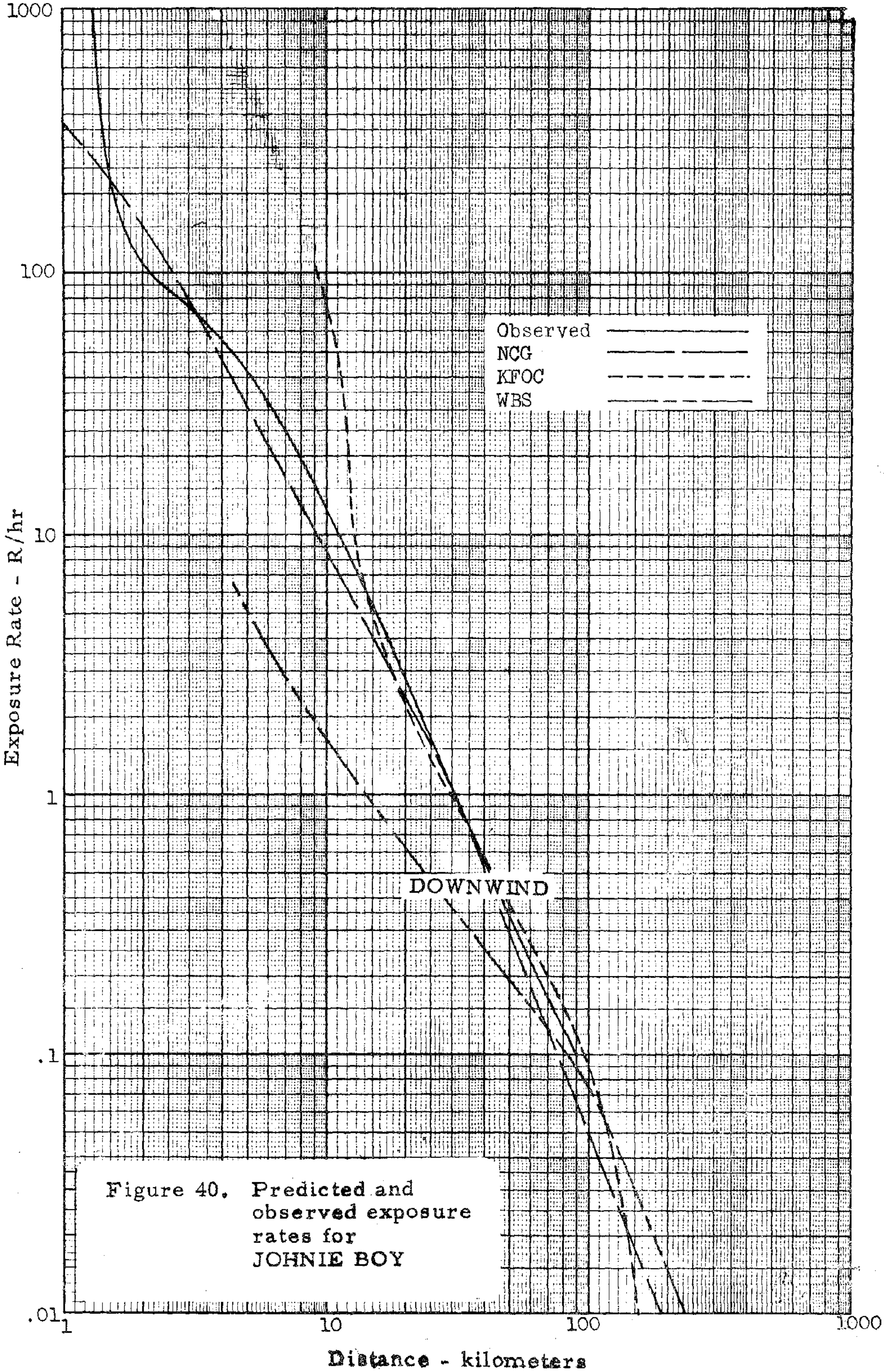


Figure 40. Predicted and observed exposure rates for JOHNIE BOY

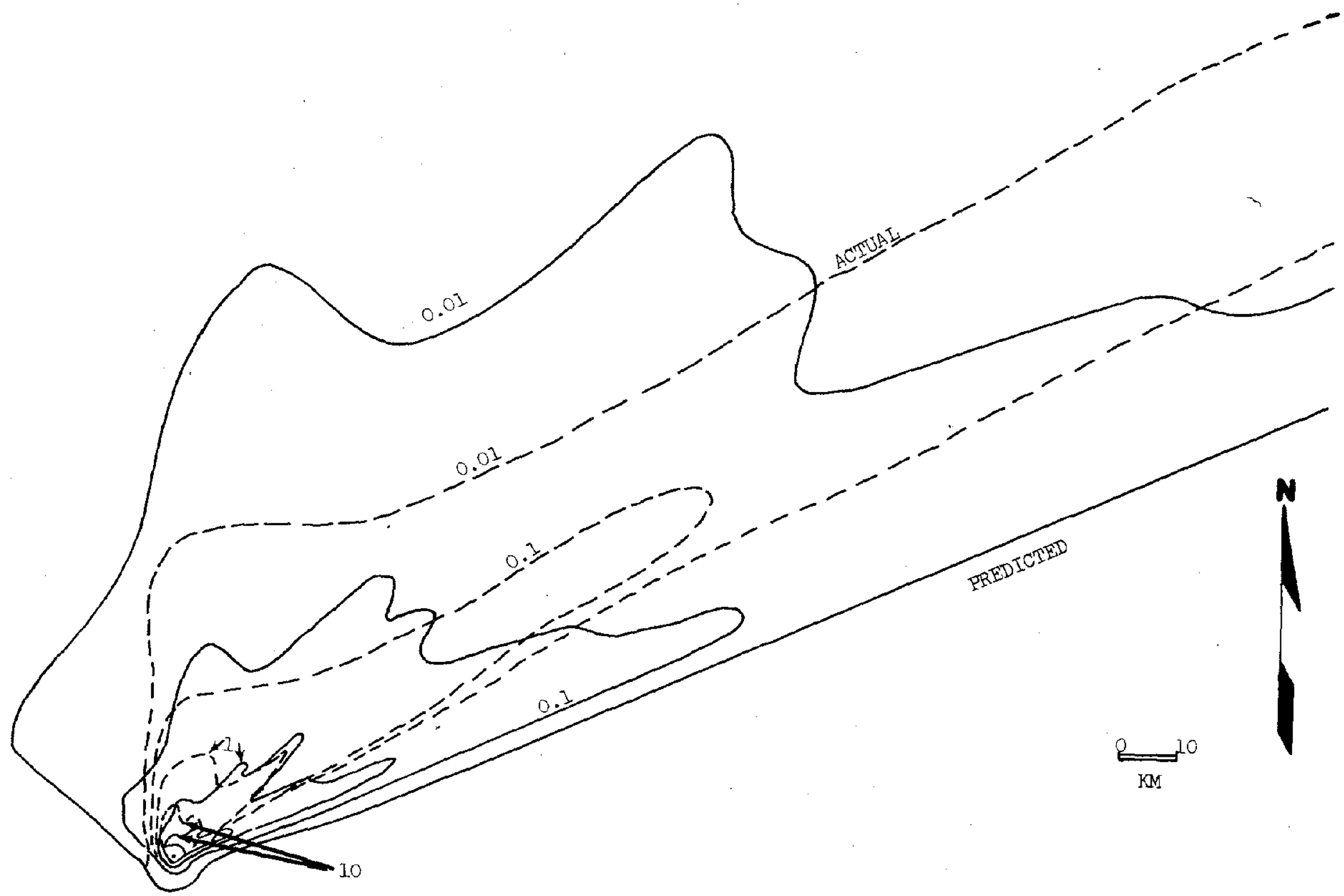


Figure 41. SCHOONER fallout pattern as predicted by NCG scaling model. Exposure rates at H+1 in R/hr.

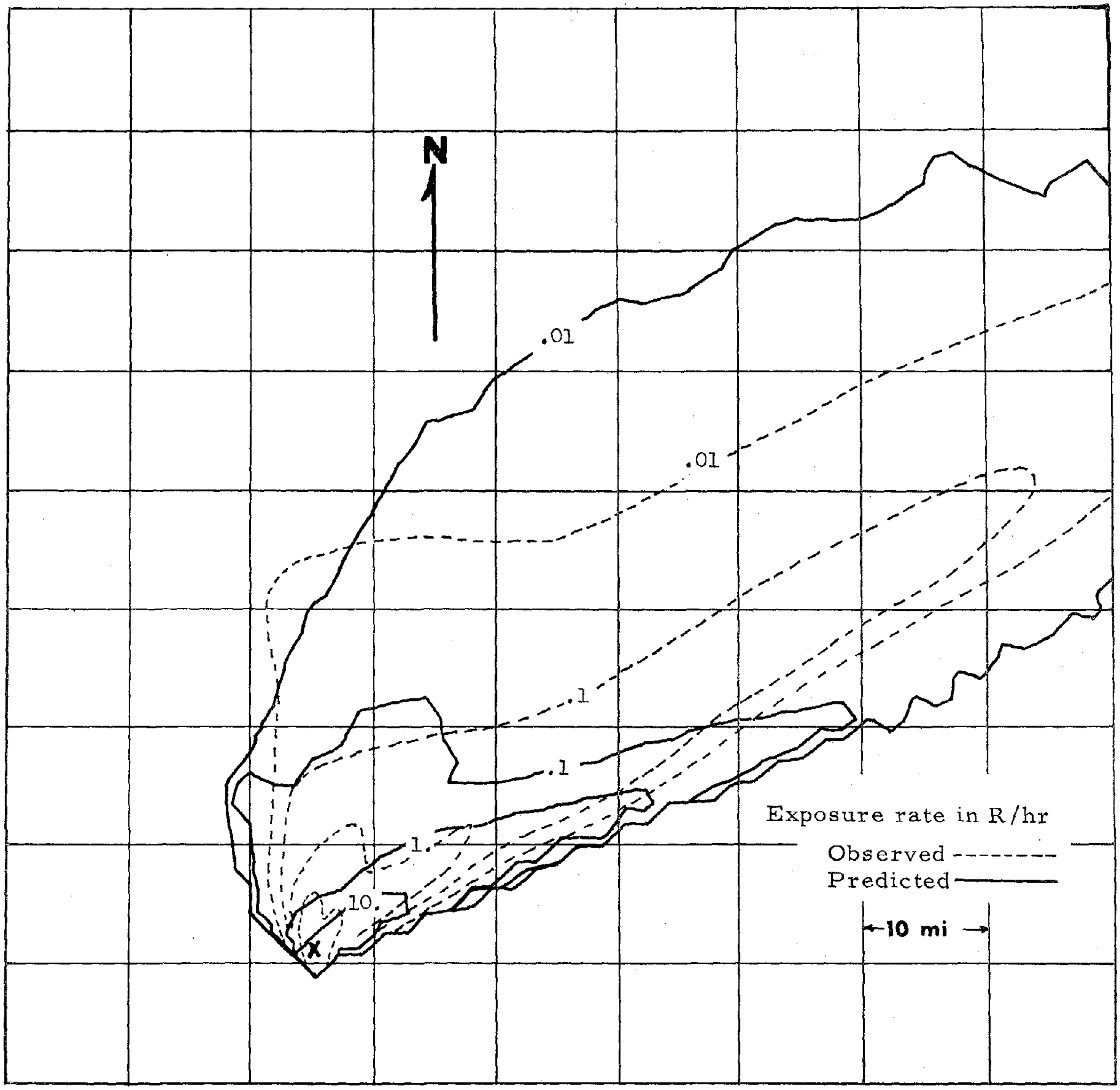


Figure 42. SCHOONER fallout pattern as predicted by KFOC using post detonation winds.

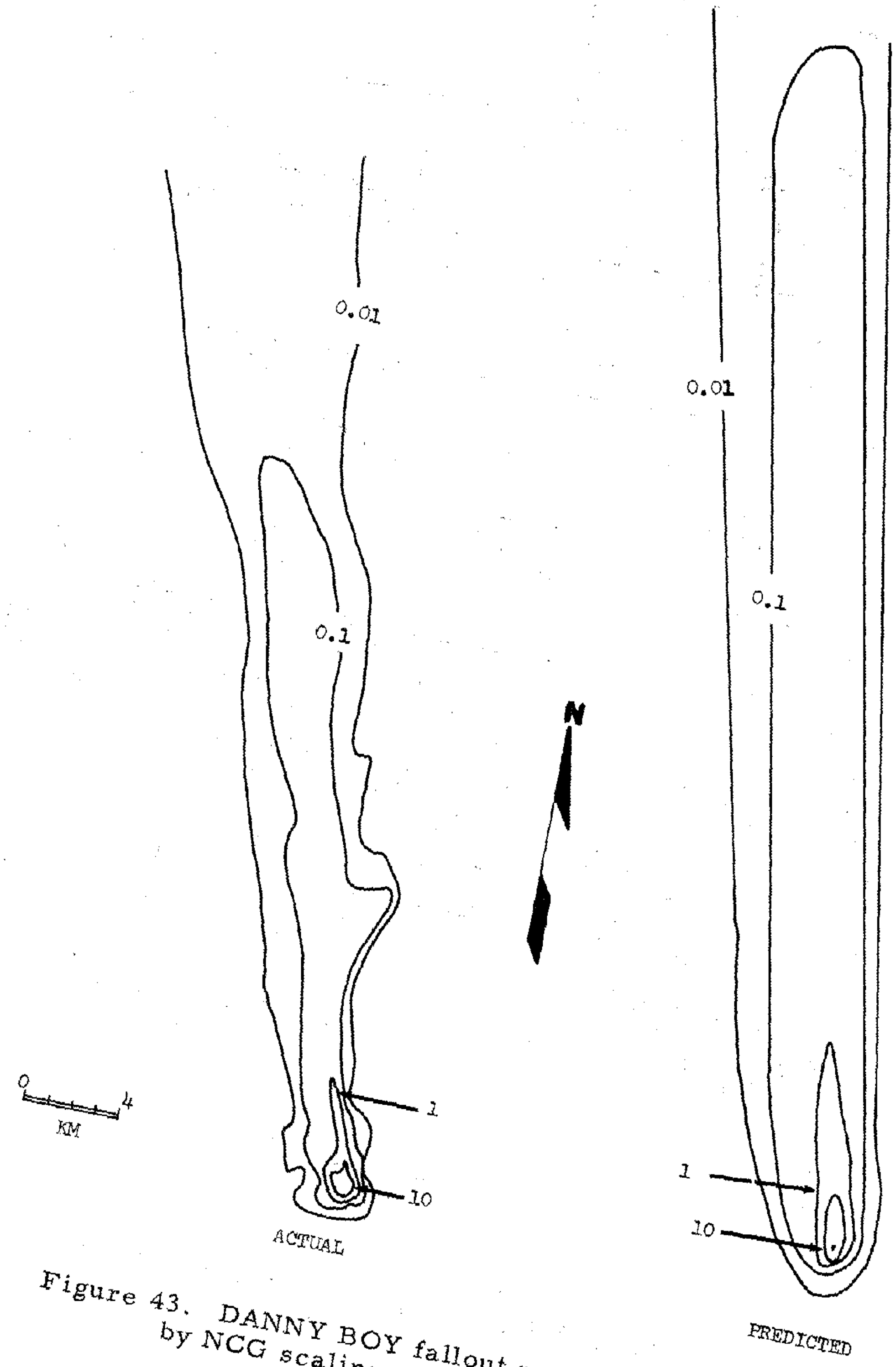


Figure 43. DANNY BOY fallout pattern as predicted by NCG scaling model. Exposure rates at H+1 in R/hr.

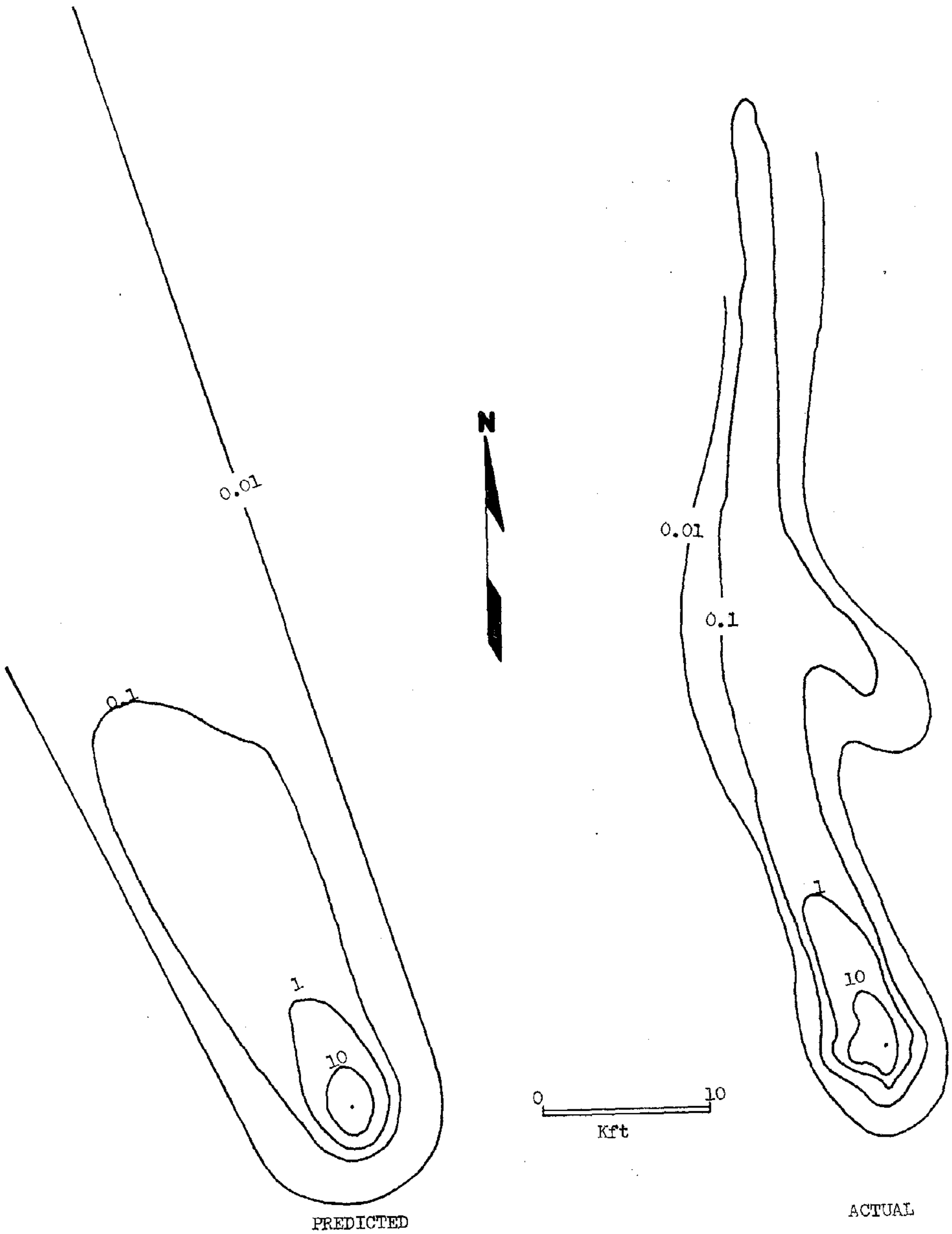


Figure 44. CABRIOLET fallout pattern as predicted by NCG scaling model. Exposure rates at H+1 in R/hr.

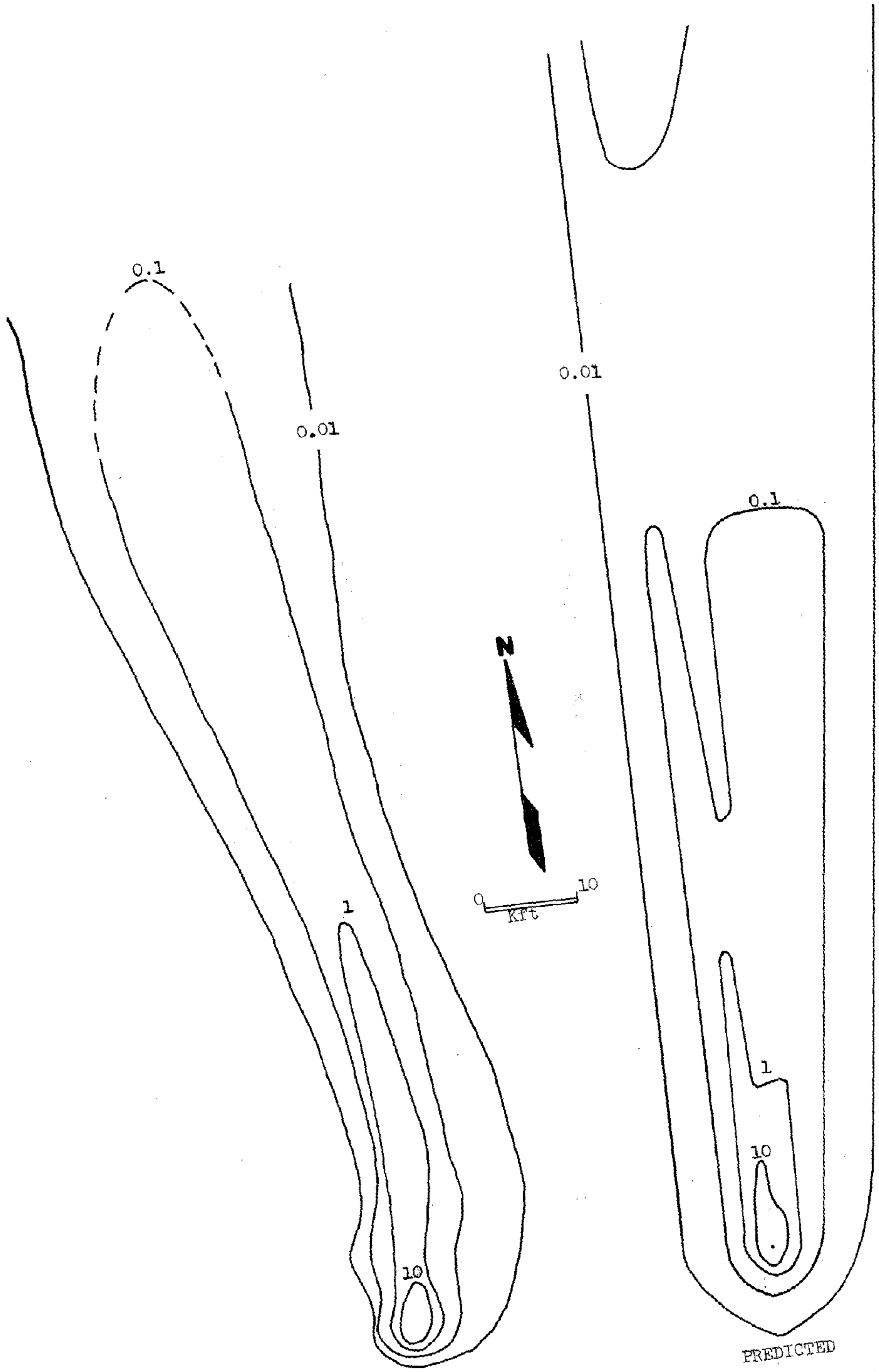


Figure 45. BUGGY fallout pattern as predicted by NCG scaling model. Exposure rates at H+1 in R/hr.

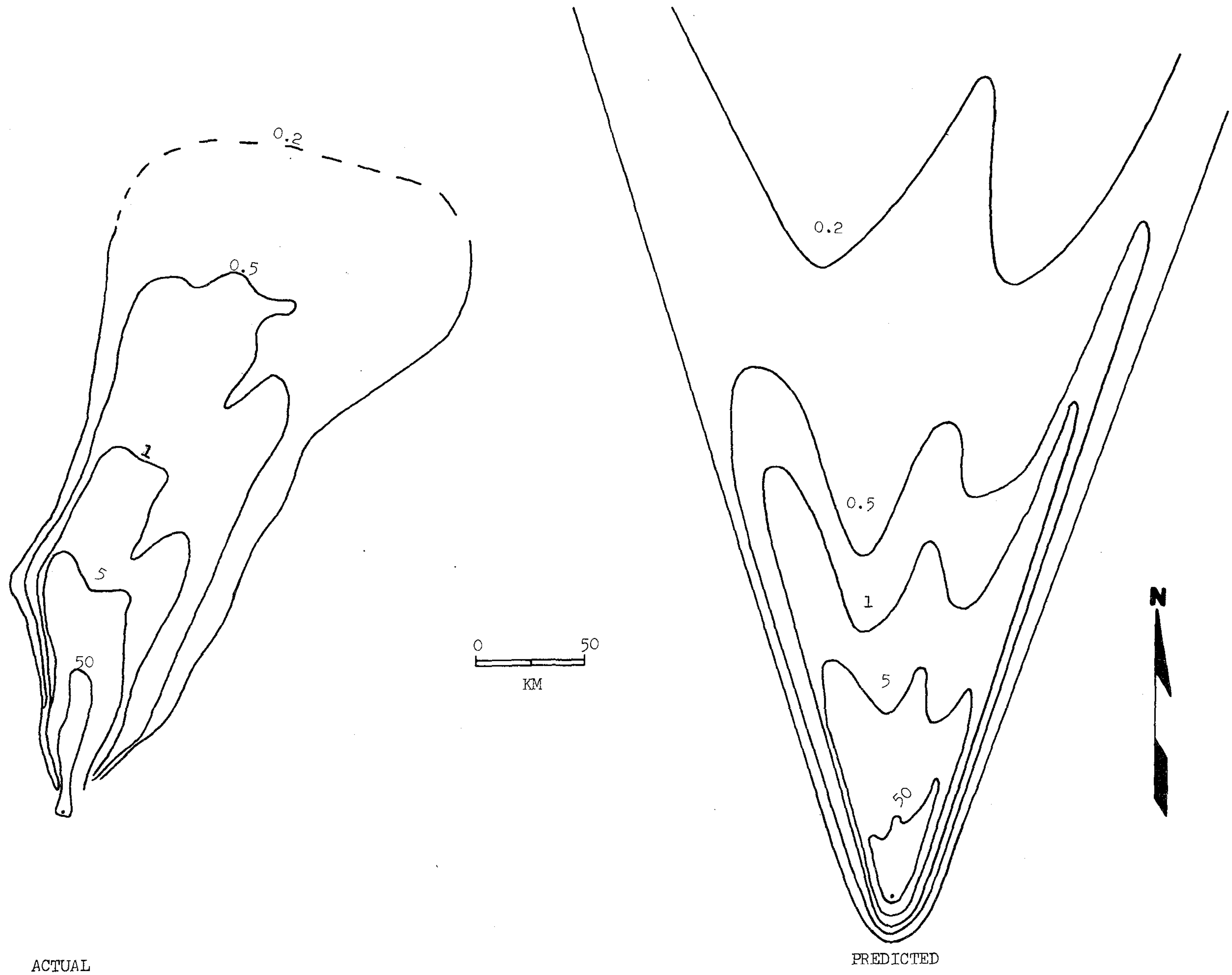


Figure 46. SEDAN fallout pattern as predicted by NCG scaling model. Exposure rates at H+24 in mR/hr.

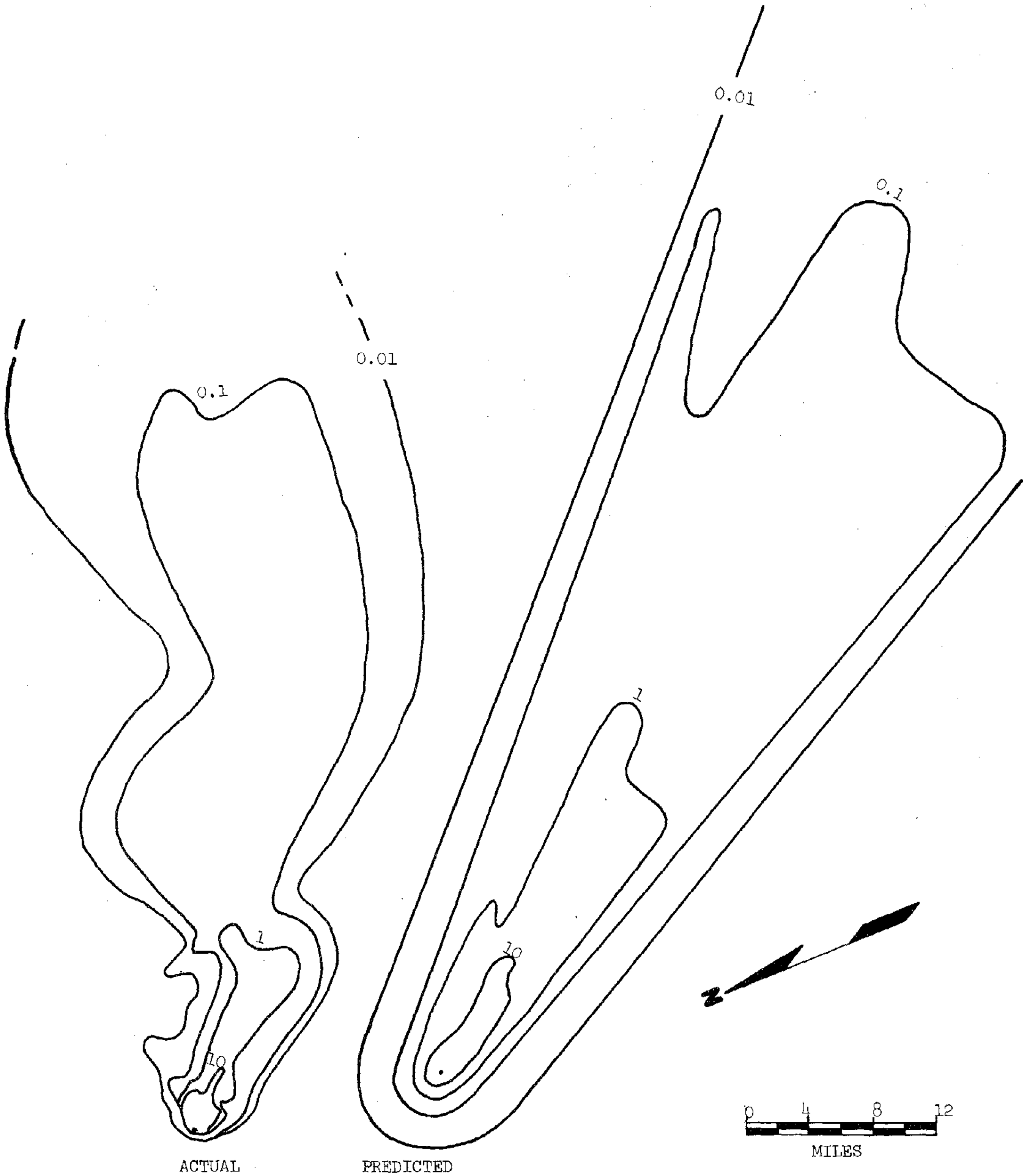


Figure 47. TEAPOT ESS fallout pattern as predicted by NCG scaling model. Exposure rates at H+1 in R/hr.

REFERENCES

1. M. D. Nordyke and M. M. Williamson, The SEDAN Event, Lawrence Radiation Laboratory, Livermore, Rept. PNE-242F (1965).

2. J. B. Knox, "A Cratering Fallout Model (KFOC)," Radioactivity Released from Underground Nuclear Detonations: Source, Transport, Diffusion, and Deposition (U), Lawrence Radiation Laboratory, Livermore, Rept. UCRL-50230, May 1967 (SRF).

3. W. C. Day, Cloud Dimensions for Cratering Explosions, U. S. Army Engineer Nuclear Cratering Group, Livermore, Memo. NCG/TM 66-8 (1966).

4. B. C. Hughes, Nuclear Construction Engineering Technology, U. S. Army Engineer Nuclear Cratering Group, Livermore, Rept. NCG/TR-2 (1968).

5. F. D. Cluff and T. R. Palmer, A Fallout Scaling Model for the Prediction of Gross Gamma Dose Rates from Earth Cratering Detonations, U. S. Weather Bureau (unpublished paper).

6. W. C. Day, Dose Rate Predictions in Crater, Lip, and Upwind and Crosswind Base Surge Areas for Individual Detonations of Rte. 17A (U), Rept. COPKE 67-30 (1967). (SRD)

7. M. D. Nordyke, H. B. Keller, and M. M. Williamson, "Nuclear Explosives and Radiological Safety" (U), Appendix 1, Incl. B, Isthmian Canal Studies - 1964, Lawrence Radiation Laboratory and U. S. Army Engineer Nuclear Cratering Group, Livermore, Rept. PNE 2002 (1964). (SRD)

8. T. A. Gibson, Jr., Lawrence Radiation Laboratory, Livermore, private communication.

9. T. A. Gibson, Jr., Fallout Predictions: Fraction of Radioactivity in Pattern as a Function of Water in Medium, Lawrence Radiation Laboratory, Livermore, Memo UOPKG 68-39 (1968).

10. M. M. Williamson, Activity Release from Several Nuclear Cratering Detonations (U), Lawrence Radiation Laboratory, Livermore, Rept. UCRL-14184, May 1965 (SRD)

11. H. A. Tewes, CABRIOLET: D + 7 Day Evaluation (U), Lawrence Radiation Laboratory, Livermore, Rept. COPKG 68-7 (SRD)

12. J. Toman, BUGGY: D + 7 Day Evaluation (U), Lawrence Radiation Laboratory, Livermore, Rept. COPKG 68-2 (SRD)

13. H. A. Tewes, SCHOONER: D + 7 Day Evaluation (U), Lawrence Radiation Laboratory, Livermore, Rept. COPKG 68-31 (SRD)

14. A. V. Shelton, Lawrence Radiation Laboratory, Livermore, Memo UOPAC-61-229 (1961).

15. Military Engineering with Nuclear Explosives, U. S. Army Engineer Nuclear Cratering Group, Livermore, Rept. NCG/TR-1 (1966).

16. J. V. Crawford, T. A. Gibson, D. Burton, Lawrence Radiation Laboratory, Livermore, Memo UOPKA 69-38.